AEROVATIONS

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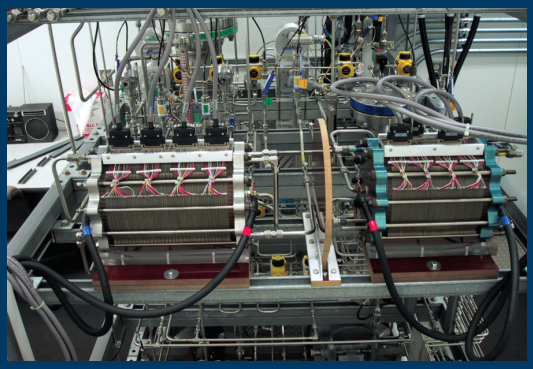
From Concept to Capability

NASA SBIR/STTR contracts are key to developing new technologies and creating new tools. Rolling Hills Research Corp. offers one program success story, page 5

Photo courtesy Rolling Hills Research Corp.

Ophir Corp. wants to fly, page 3



Lynntech fuel cell is ready, page 6

SBIR STTR

Government researchers, small business owners and members of the U.S. Congress agree that programs contribute to new technology development

By Jay Levine
X-Press Editor

NASA's Small Business Innovation Research program and Small Business Technology Transfer program are engines for starting up new technologies and industries and providing researchers with valuable tools for exploring the unknown, defining research paths and identifying advancements in revolutionary technologies.

The U.S. Congress has strongly supported these programs, which have seen worthy proposals go forward in each state – to the tune of 6,957 SBIR contracts awarded nationally between 1983 and 2000. The SBIR/STTR programs have provided a stable revenue stream in the research and development environment, where the problem of shrinking discretionary funds is commonplace. For Dryden, the SBIR/STTR programs also offer a route to acquiring funding and staff to help achieve research goals.

"I think the best use of the SBIR/STTR program is to assist the government in developing needed technology through the capability and creativity of small businesses," said Rod Bogue, Dryden's SBIR/STTR program manager. "One valuable contribution is the technology that results from SBIR/STTR contracts, but in addition valuable contacts are established between the participating companies that often persist into other activities. Another benefit is to make fresh ideas from the private sector available to the government to assist in meeting requirements to support national objectives."

That is a sentiment shared by John Del Frate, who managed a SBIR contract on fuel cell development (see related story).

"I think it's a healthy process," Del Frate said. "There's a certain beauty to working with small companies because they're very keen on meeting your needs. They have very little or no bureaucracy yet so they move fast. It's exciting to be associated with them. It's not like the 800-pound gorilla, where it's hard to get someone's attention and they have other things they're more interested in or (that) have greater revenue capability.

"The bottom line is it's good for our country and it's good for us. And there are some exciting opportunities out there."

Does this sound too good to be true? Consider this: funding for SBIR contracts in 2005 was $107.5 million, with STTR programs receiving another $12.9 million. Allocation of the funds is determined by the merit of the proposals, and not the geographical area from which they are submitted.

Marty Brenner, SBIR manager for the Modeling, Identification and Simulation for Control of Aerospace Vehicles subtopic, said SBIR/STTR contracts have a big up side.

"A valuable contribution of the SBIR/STTR contract is good coordination between contractor/university and NASA facilities in developing novel hardware and software solutions for promoting NASA's goals, assisting in the small business commercialization strategy and integrating university expertise in a collaborative process among commercial interests, government and academic research," he said.

Larry Fruedinger, a former SBIR contract technical monitor and SBIR subtopic manager for the Automated and Online Data Reduction category, knows the value of these contracts.

"Some companies build a better mousetrap that catapults them to revenues in the millions," he said. "Other companies work on mousetraps for smaller markets, or work on mousetraps with markets that are still years away from being ready to accept the new mousetrap. The success of SBIR is to establish an environment for invention of new mousetraps."

In NASA's quest for that next mousetrap, Dryden has primary responsibility for three SBIR subtopics: Revolutionary Atmospheric Flight Concepts; Modeling, Identification and Simula-

See SBIR/STTR, page 4

Just the facts

Resources for putting together proposals for Small Business Innovative Research and Small Business Technology Transfer proposals, and additional information on the programs, are available at:

- The NASA SBIR Web site is http://sbir.nasa.gov
- The Small Business Association has an SBIR Web site at http://www.sbaonline.sba.gov/SBIR/indexs-bir-sttr.html
- NASA's Participation Guide is available at http://sbir.gsfc.nasa.gov/SBIR/partintro.htm
- SBIR World is located at http://www.sbirworld.com
- In-Know-Vation Online also has valuable information at www.inknowvation.com

For more information: Dryden Flight Research Center Public Affairs Office (661) 276-3449

Possibilities

SBIR/STTR is all about what can come of a good idea. Ophir Corp. has seen what can happen, and may one day have a new product on the ER-2

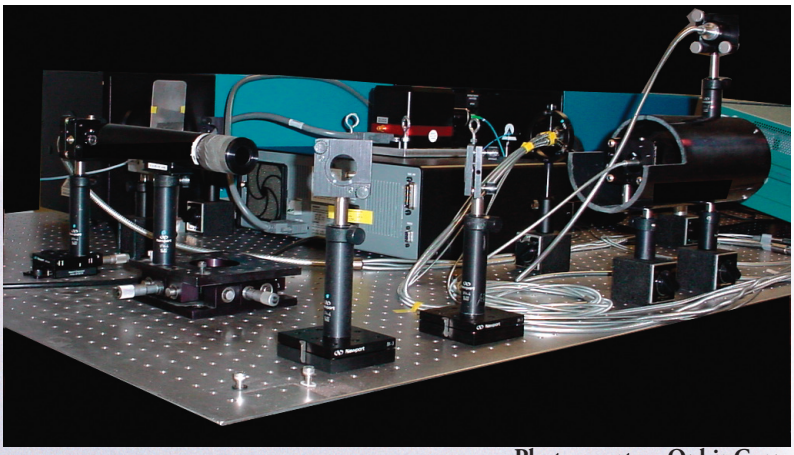


Photo courtesy Ophir Corp.

Above, the hardware setup on the table comprises components of Ophir's lidar prototype optical transceiver that could represent a new way of collecting air data. The hardware could one day be flown on a NASA ER-2 (Background image, NASA photo EC05 0224-37 by Tony Landis).

By Jay Levine
X-Press Editor

When a project involving a Small Business Innovative Research contract succeeds, there are many winners.

Researchers get a new tool or data to add to their knowledge base, government research and development funds prove to have been well spent and companies get a new product to sell. Even communities can realize benefits, through the addition of new jobs.

The Ophir Corp. of Littleton, Colo., offers an example of how some companies attain the ultimate goal SBIR contracts were designed to achieve – a commercial product to market.

In a recent interview with Ophir's business development staff, staff members explained how the program has benefited their work and how their efforts have benefited researchers and industry. Among those at the interview were Martin O'Brien, Ophir vice president; Lisa Spaeth, director of business development; and Connie Williams, a business development staff member.

"The SBIR program has enabled Ophir to take concepts from mere ideas on paper to actual avionics systems that are currently operational," Spaeth said.

This year, Ophir Corp. celebrates its 25th anniversary. The company has built its reputation and its success on development and manufacturing of atmospheric sensing instruments. As part of the Ophir business plan, SBIR contracts have proven to be a valuable asset. In addition to four contracts with Dryden (two SBIR Phase I and two Phase II contracts), Ophir has entered into a total of more than 50 SBIR contracts for federal agencies such as the Department of Energy, the Environmental Protection Agency and the Department of Defense.

"The SBIR program has been critical in our technology-development path to successful commercialization," said Spaeth.

The bulk of Ophir's SBIR-related research has been concentrated on three technologies.

Ophir's air temperature radiometer – essentially, O'Brien explained, "a fancy thermometer" – "which was the by-product of one of the NASA Dryden SBIR Phase I and Phase II projects (Real-Time Remote Sensing Air Temperature Radiometer for High Speed Aircraft) is now resident at the National Center for Atmospheric Research. This radiometer was successfully demonstrated under the SBIR program and continues to be used for atmospheric research," Spaeth said. In addition, The Boeing Company flight test group flew this prototype sensor as part of Phase II research.

A second success came with technologies developed as a result of several other SBIR contracts. Research in two sensor-technology areas, measurement of atmospheric humidity and temperature, were funded through separate SBIR projects with the U.S. Navy, U.S. Army and the National Science Foundation.

The result of those contracts was product development and subsequent production of the only laser radar currently flown on the B-2 stealth bomber. The product, called the Pilot Alert System, uses laser radar to "look" into the atmosphere and detect conditions under which condensation trails may form. Ophir produced over 30 of the devices, Spaeth said.

One of Ophir's current projects involves something called Rayleigh/Mie lidar – light detection and ranging – for determination of air data parameters. The company recently received a patent for the technnology. Rayleigh/Mie lidar, for non-intrusive measurement of aircraft data parameters, is an optical remote sensing technique intended to replace traditional sensors used for measuring air data and wind turbulence ahead of an air vehicle.

See Ophir, page 6

SBIR/STTR ... from page 2

tion for Control of Aerospace Vehicles and Flight Sensors, and Airborne Instruments for Flight Research. In fiscal year 2005, Dryden received 24 STTR proposals and 133 SBIR proposals (see related story on current Phase II contract awards).

Proposals for NASA SBIR contracts are written against Agency needs identified in the Agency-wide solicitation issued each year. Specific needs are organized into application area subtopics. In addition to the three subtopics listed above, Dryden also assists with subtopic evaluations in eight other subtopics managed at Ames Research Center, Moffett Field, Calif.; Glenn Research Center, Cleveland; Johnson Space Center, Houston; Langley Research Center, Hampton, Va.; and Marshall Space Flight Center, Huntsville, Ala.

Congress created the SBIR program in 1982 to provide avenues through which small businesses could participate in government research and development and as a means of increasing national employment and improving U.S. competitiveness.

The STTR program was created in 1994 for similar reasons. Additional opportunities the two programs were designed to create for small businesses include cooperative research and development with a nonprofit research institution and intellectual property (research findings, usually in the form of patents, copyrights, trade secrets, or proprietary data) exploitation among research institutions.

The programs have many similarities and share the same three-phase structure. The first phase examines the merit of a good idea or concept. Phase I contracts deemed worthy of additional support are approved for further refinement in a Phase II contract. Ultimately, the goal of both programs is to enter a third phase, in which the idea or concept becomes a commercial product, or the project is funded entirely from a company or government entity outside the parameters of the SBIR/STTR program. Once an idea or concept becomes a commercial product or has outside partners it is considered a success story.

> ***"Some companies build a better mousetrap that catapults them to revenues in the millions. Other companies work on mousetraps for smaller markets, or work on mousetraps with markets that are still years away from being ready to accept the new mousetrap. The success of SBIR is to establish an environment for invention of new mousetraps."***
>
> **– Larry Fruedinger, a former SBIR contract technical monitor and SBIR subtopic manager for the Automated and Online Data Reduction category**

An SBIR contract enables government researchers to find small business partners with common technology-development interests. NASA Phase I contract awards are usually made in November, with six-month contracts worth up to $70,000 for SBIR work and one-year contracts with funding up to $100,000 for STTR contracts. A Phase 1 contract is expected to prove the proposed concept by a convincing demonstration sufficiently persuasive to merit a Phase II award. This work often results in a physical working model or a software package that makes the benefits of the concept obvious to interested patrons.

A company is considered a qualifying small business if it numbers fewer than 500 employees, is based in the U.S. and is organized for profit. The company also must perform the bulk of the research for those proposals.

The contracts are awarded based on feasibility and technical merit. Typically, awards are made in the areas of emerging technologies, scientific breakthroughs, novel applications of existing technologies and new capabilities or major improvements to existing technologies.

Those projects that advance to Phase II – which number just under half, or about 45 percent of Phase I entries – can receive a contract worth up to $600,000 over 24 months to breach technology barriers and develop prototype solutions to address needs described in contract solicitations. These awards usually are made in July or August and usually culminate in a product prototype that will demonstrate benefits beyond those shown in Phase I. In addition to the technical advances in Phase II, the small business is expected to provide a business case for the proposed product to include market analysis, financial planning and business expertise beyond that required in technical areas.

SBIR/STTR proposals are funneled to the NASA center that manages the SBIR/STTR subtopic under which the proposal was submitted. Center representatives review all proposals and at least two evaluations are performed for each proposal. In some cases, more evaluations are needed when there is a difference of opinion between two evaluators.

The evaluators work independently and judge proposals on technical merits. The most innovative and promising proposals are selected. Each evaluator comments on the proposals and justifies his or her recommendations, especially regarding the value to NASA and to the center involved. The reviewers are technically qualified individuals assigned by organizational leads at each center. A Web site is used to facilitate the evaluation process, assure that legal requirements are satisfied and provide an on-line repository for evaluator findings.

Technical factors, commercial merit, expected benefits to NASA and feasibility are assessed by evaluators and forwarded to the respective subtopic managers for review and recommendation to the ranking board. Findings from the evaluator assessment are forwarded to the proposal's authors to provide feedback in case the proposal is not selected for an award. This is to provide help to the respective small businesses should they decide to improve the proposal for re-submission at a later date.

Researchers are encouraged to find a small business working on technology that may be useful in addressing center needs (see related story). They can help the company's leadership understand the center's requirements and if appropriate, urge them to submit an SBIR proposal for consideration. Researchers may volunteer to evaluate the proposal when it is submitted and serve as NASA's technical representative overseeing the contract if the proposal is awarded.

The hands and minds of innovative researchers struggling today with tomorrow's challenges are supplying the technology pipeline with solutions and opportunities. When it comes to solving problems, NASA's SBIR/STTR program is a proven tool.

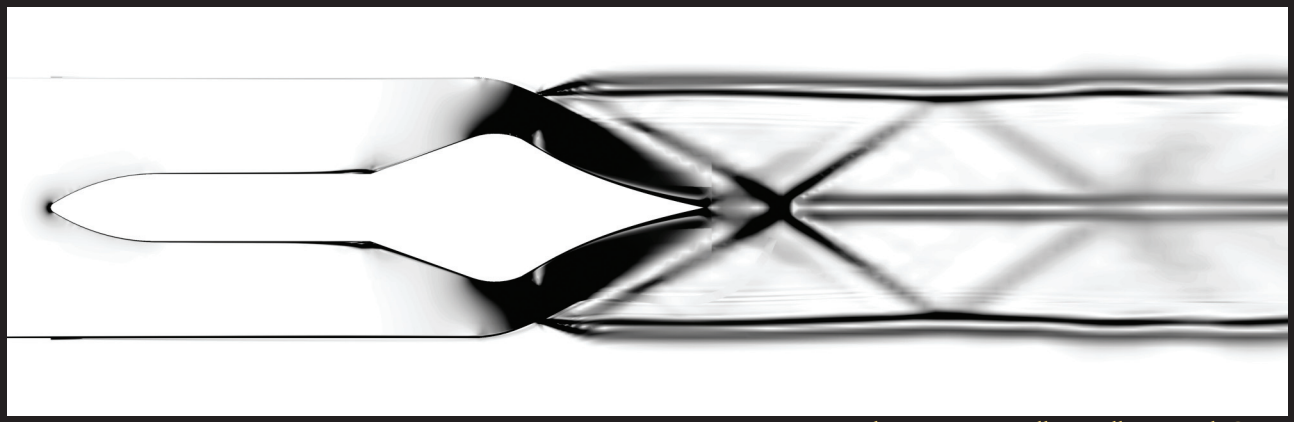


Photo courtesy Rolling Hills Research Corp.

Rolling Hills Research rolls along with SBIR/STTR

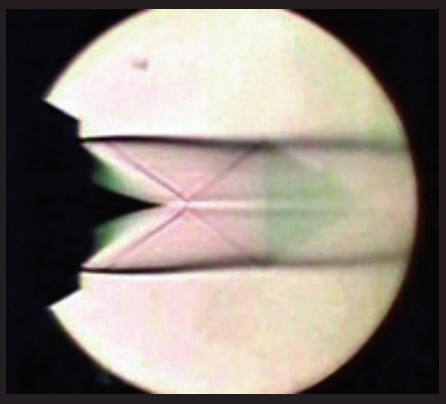


Photo courtesy Rolling Hills Research Corp.

The image at left is a color Schlieren photo of an aerospike nozzle firing, taken at Cal Poly, San Louis Obispo in the university's cold-flow facility. The test technique indicates changes in density, an indicator of the formation of a shock wave. The image above offers a computer-generated prediction of what the nozzle's exhaust plume would look like. The similarity in the shock diamonds can be clearly seen.

By Jay Levine
X-Press Editor

The successes of the Rolling Hills Research Corp. illustrate all that NASA's SBIR/STTR contracts are designed to achieve: creation of a new tool for researchers to use in expanding their knowledge base, and giving small companies opportunities to collaborate with government and academic institutions for mutual benefit. The end result, when everything goes as planned, is new commercial products that offer innovative solutions to old problems.

Brian Kramer, Rolling Hills president and chief executive officer, called his experience with SBIR/STTR programs "exceptional."

No stranger to the program, Kramer first began submitting proposals while a principle investigator at Eidetics Corp., a Los Angeles-based aeronautical research company, in 1991. His focus there was on aeronautical technology development and aircraft simulation, and his boss was Jerry Malcolm. Malcolm later was Dryden's assistant director for research engineering.

In fact, when Kramer established El Segundo-based Rolling Hills Research Corp. in 2002, he bought the rights to aeronautics technologies for which he led development efforts while at Eidetics. So while Rolling Hills is just three years old, the company's experience in aeronautical research actually extends back longer than a decade.

"The process (of submitting an SBIR/STTR proposal) is pretty simple," Kramer said. "The proposal itself has a very specific format that's required and it's limited to only 25 pages. You can't go too wild

See Rolling Hills Research, page 11

Photo courtesy Rolling Hills Research Corp.

Rolling Hills Research Corp. President Brian Kramer, left, and Michael Kerho, the company's chief aerodynamicist, are pictured at an American Insitute of Aeronautics and Astronautics event promoting the company's water tunnels and research capabilities. On the front cover is the F-16XL water tunnel model, used for time-dependant aerodynamics work that is part of an SBIR contract with Langley Research Center, Hampton, Va.

Advancing aerona

Researchers say NASA proposals advance know

By Jay Levine
X-Press Editor

Small Business Innovative Research and Small Business Technology Transfer contracts are tools for researchers seeking to explore new ideas and concepts, or to eliminate research paths unlikely to pay off.

Dryden engineer Al Bowers oversees SBIR proposals under the Revolutionary Concepts for Flight subtopic.

"There are a lot of great ideas that come out of academia and working with students," Bower explained. "What we're trying to do (through SBIR contracts) is come up with innovative ideas – a little bit 'out of the box' – that (Dryden) might not have come up with or that (Dryden) can't spend research dollars on, but that other people might be willing to pursue."

Sometimes those innovative ideas, seeded by SBIR/STTR contracts, grow into valuable tools for researchers, or help mature new concepts to a stage that gives researchers a knowledge base for starting their own projects.

Many small companies focus on fundamental aeronautics research. Work in that field is key to NASA's goals. Among areas of interest for the Agency are fundamental high-altitude technologies; projects that sharpen understanding of aircraft control systems; innovative uses for adaptive control systems; and examination of how structures and aeroelastic properties relate. Technology developments that could benefit low-speed, high-flying planetary vehicles are another area in which SBIR and STTR contracts could support NASA research, Bowers added.

The flexibility of small businesses is another advantage inherent to the SBIR process, Bowers said. He said he also has an appreciation for STTR contracts, of which universities and other research institutions are often 0a part.

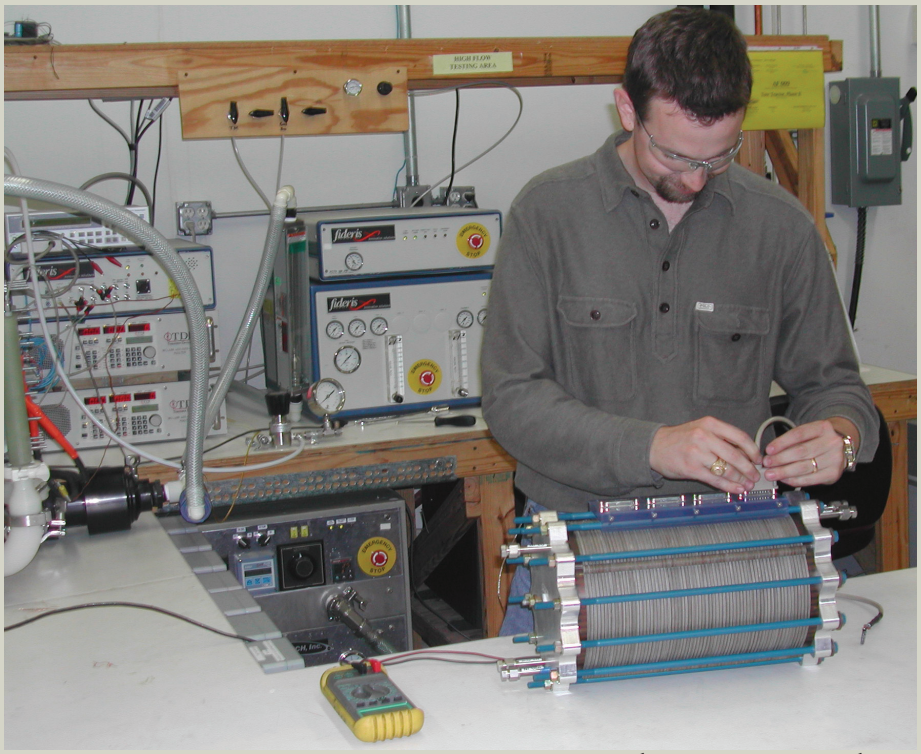


Photo courtesy Lynntech Inc.

At left, Ly company's view of th altitude a sible to sto At right, t search Ce Del Frate like to see ity and fu

Rod Bogue, Dryden's SBIR project manager, shares these sentiments.

"(Researchers) can use the SBIR/STTR program to support or augment their work. The SBIR/STTR program is designed to develop technology for use in NASA programs," Bogue said.

Key technologies or research paths Dryden engineers have refined or established through SBIR/STTR contracts are profiled in a series of articles highlighting SBIR success stories, available on the NASA SBIR/STTR contract Web site (see related story). At Dryden, perhaps the most widely recognized of these is a product arising from SBIR contracts with New Hampshire-based Creare Inc., through which Ring Buffered Network Bus software (marketed as RBNB DataTurbine) was developed. This product enables researchers to capture and process live data streams while making the data available for viewing with Internet browsers.

Other SBIR proposals also have produced innovative successes. Different researchers will name different small businesses that have contributed to technology solutions with their various SBIR/STTR proposals, but the companies have common characteristics requisite to the SBIR process – cutting-edge ideas, and a can-do attitude.

As one example, "We have a long history of developing sensors with Luna Technologies, particularly in the area of fiber optic sensors that are useable in high-temperature environments," Bogue said, citing a Blacksburg, Va.-based company that specializes in optical sensors.

SBIR/STTR work allows fundamental aeronautical concepts such as boundary layer control with mechanical mixing to be explored. One company, for instance, sought to determine the size of vortex generators needed to address such issues, which crop up in

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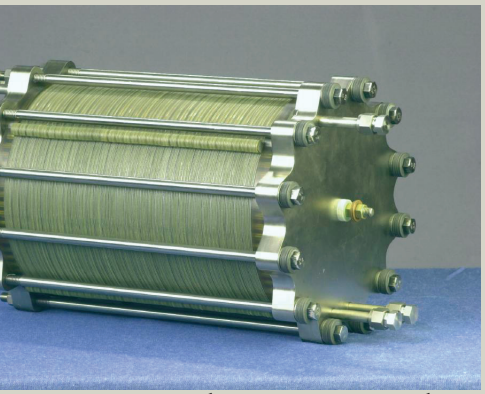
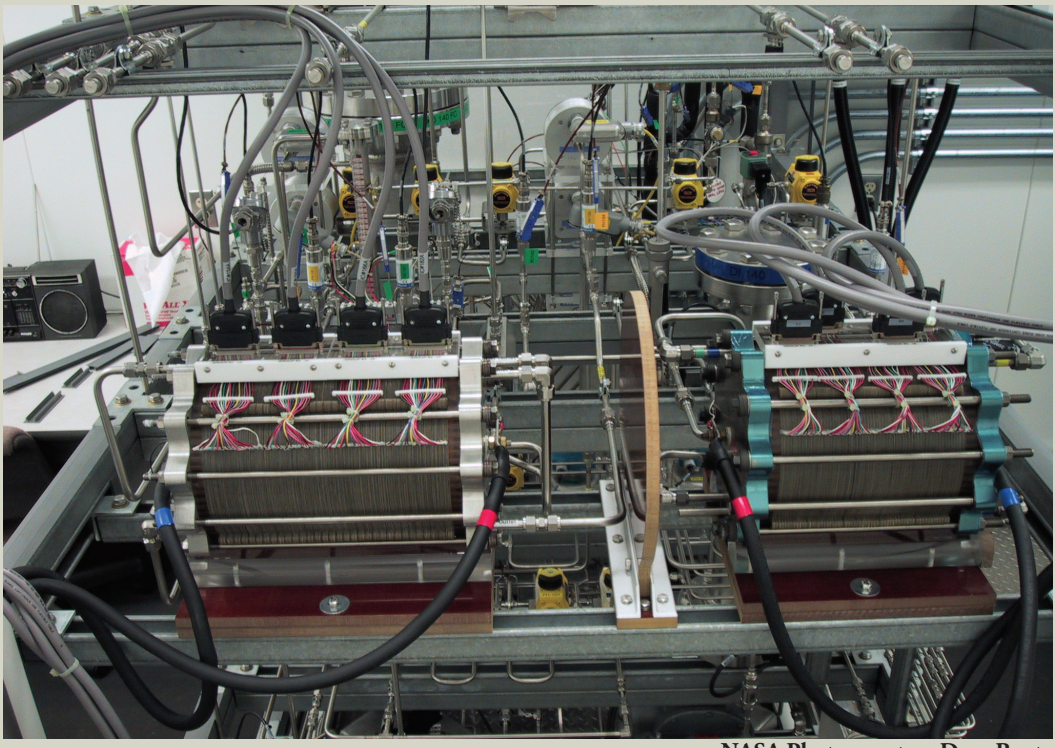


Photo courtesy Lynntech Inc.

nntech Inc. employee James Layton works on the fuel cell stack. The above image shows a closer e device that could be key for long-duration, high-rcraft missions. The component could make it pos-re energy during the day for use during the night. wo fuel cell stacks are tested at NASA Glenn Re-nter, Cleveland. Researchers like Dryden's John see the potential of the fuel cell stacks and would hundreds of such tests to investigate their durabil-nction.



NASA Photo courtesy Dave Bents

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is advice for companies
R/STTR proposals: do
Some proposals may be
leas, but ideas that have been tried before and failed. Rolling Hills Research Corp. is among companies that have effectively exhibited their capabilities through SBIR contracts.

"That SBIR contracts can also serve as a training ground for getting a pool of talent we can call on is a great thing," Bowers said, and pointed to an X-43-related development as one such example.

"We needed help on an aero model for Hyper-X program about a year and a half ago. The Rolling Hills guys were finishing an SBIR with us and I said, 'They have the talent; they could do the job for us.' And because we already had a SBIR contract with them, we could add a task (to the existing contract scope), the X-43A team could put money on the contract and (Rolling Hills employees) could crunch down through that Hyper-X work for us right away.

"They did an outstanding job, and they were able to turn (the work) around faster than if we would have had to hire someone. They were on the ground, ready to go and waiting. To be able to do that is an amazing thing – to crank something up as fast as we did. It was literally two weeks from the time we knew we had a problem and knew we needed to have work done to when they were crunching numbers for us. That's really hard to do with any other mechanism in the government."

An SBIR proposal by Lynntech Inc., of College Station, Texas, offered another example of how small businesses make key contributions.

John Del Frate was Dryden's technical representative on a Dryden SBIR proposal with Lynntech for lightweight hydrogen and oxygen fuel cells and electrolyzers. Because the company achieved key goals in developing the two technologies during two initial SBIR contract phases, Dryden engineers, in partnership with AeroVironment of Monrovia, Calif., chose to pursue additional work outside the scope of the original contracts.

Researchers in NASA's Environmental Research Aircraft and Sensor Technology, or ERAST program, "were looking for a really lightweight energy-storage system - much lighter than even today's rechargeable batteries," Del Frate said. The regenerative fuel cell concept seemed to allow for the lightest approach to developing the system. We wanted to be able to store the excess electric power produced by the solar array on the airplane during the day for use as nighttime power so we could keep on

See Researchers, page 10

Ophir ... from page 3

In the Dryden SBIR efforts (Phases I and II) Ophir demonstrated a Rayleigh/Mie laser radar approach for measuring velocity, atmospheric temperature and atmospheric pressure. These parameters can be used to determine all required aircraft air data parameters, such as true airspeed, Mach number, angle of attack, atmospheric temperature and atmospheric pressure.

Through this project work researchers sought to resolve the problem of determining characteristics of the air outside the boundary layer of an aircraft. This process involved use of a single sensor to replace conventional air data sensors, which are prone to failures such as icing and plugging of aircraft pitot (air data measurement) tubes. An optical air data sensor of the type developed during the course of the research provides important benefits to high-performance aircraft, including improved safety. Other potential benefits are more accurate measurements at difficult aircraft attitudes; higher data update rate; reduced calibration and maintenance costs; improved fuel efficiency and measurement sensitivity.

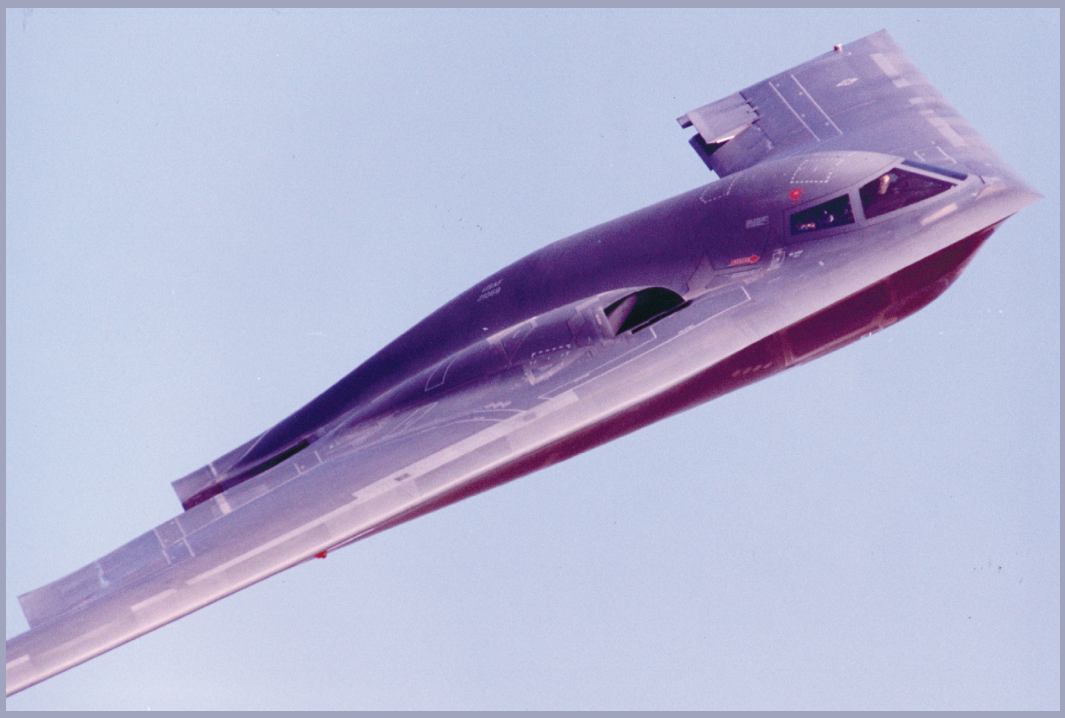
The research proved the concept behind determining air data parameters in both clear air conditions and in what are called heavy aerosol environments, or areas of atmosphere containing solid or liquid particles such as dust or pollen. Ophir's approach is a significant innovation since it can measure all air data parameters in both aerosol and non-aerosol conditions from a single sensor. This innovation also reduces life-cycle costs for the sensors by providing a more robust air data solution, one that is unaffected by environmental conditions and does not require on-aircraft calibration.

The Rayleigh/Mie lidar works by emitting laser light into the atmosphere. "Back-scattered" laser light is collected from the atmospheric region beyond the air vehicle's boundary layer. This laser light is scattered by the atmospheric aerosols (Mie scattering) and gas molecules (Rayleigh scattering), and an optical receiver collects a fraction of that light.

Measuring this frequency shift between the light that went out and the light received back allows the relative airspeed to be measured along the laser's line of propagation. If the laser light is transmitted along three different axes, then three-dimensional air velocity can be measured, providing total airspeed, angle of attack and angle of sideslip. The aircraft's airspeed is found from the Doppler shift of the Rayleigh and Mie scattering, and will therefore not fail if the air becomes too clean due to a lack of aerosols. Measuring the airspeed on three perpendicular axes allows the aircraft orientation relative to the air to be determined. The techniques of measuring relative velocity using laser light are called Laser Doppler Velocimetry systems (a well-established technology).

In order to measure atmospheric temperature and pressure, the Rayleigh (air) and Mie (aerosol) scattering components are separated by using their different frequency response characteristics. Local at-

See Ophir, page 12



EC05 0224-18 **NASA Photo by Tony Landis**

The B-2 stealth bomber benefited from Ophir's development of a laser radar to help detect condensation in the air. Called the Pilot Alert System, the technology is used on each of the U.S. Air Force's 30 B-2s.

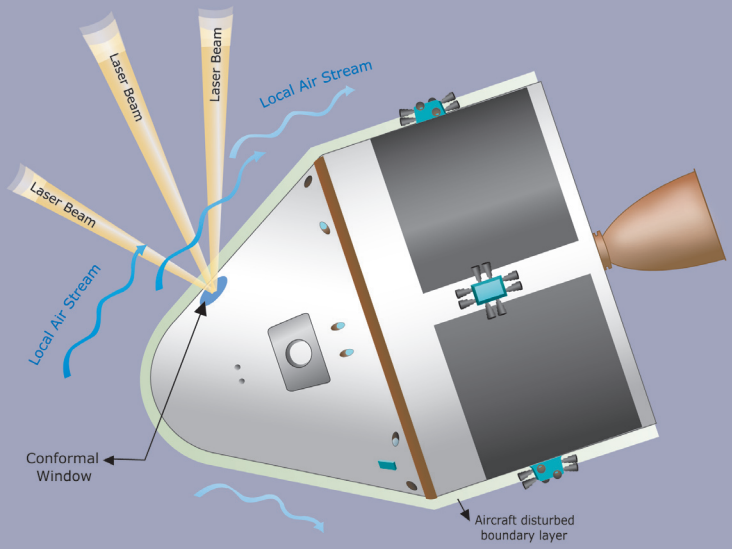


Photo illustration by Dotti Vaivoda of SmallBiz Webs, courtesy Ophir Corp.

Ophir engineers said they believe the lidar laser has potential applications for NASA's proposed Crew Exploration Vehicle.

And the winners are...

Companies selected for Phase II SBIR contracts

By Alan Brown
Dryden News Chief

Five small high-technology firms have been selected by Dryden to receive research and development contracts under Phase II of NASA's Small Business Innovation Research program.

The five firms' proposals were among 140 selected for funding by NASA under the Agency's 2004 SBIR program, and are valued at up to $600,000 each over a two-year performance period. The proposals fall into two research areas defined in the SBIR process, airspace systems and vehicle systems.

Following are summaries of the Phase II projects funded with the recent awards by Dryden:

• Kalscott Engineering Inc., Network Centric Transponders for Airspace Integration of UAVs

Kalscott's contract calls for the firm to develop a miniaturized network-centric transponder that would give pilots or operators of unmanned air vehicles improved situational awareness. This would support safe integration of UAVs into the national airspace at a level of safety equivalent to that currently existing with manned aircraft. The Phase II contract will culminate in flight tests of the proposed equipment.

• Rolling Hills Research Corp., Revolutionary Performance for Ultra Low Reynolds Number Vehicles

The contract calls for the firm to refine an approach to control the transition from smooth to turbulent airflow in conditions of low Reynolds numbers (low-speed flight at high altitude). The novel transition-control technology was shown to reduce aerodynamic drag penalties by as much as 35 to 60 percent when compared to traditional techniques, and increasing to as much as 190 percent at off-design conditions. The commercialization potential for the technology is extremely promising, with possible applications to micro unmanned air vehicles; high-altitude, long-endurance aircraft; Mars exploratory flyers and propeller systems.

• Continuum Dynamics Inc., Distributed Flight Controls for UAVs

The contract calls for the firm to continue developing a novel actuator for flight control applications based on shaped memory alloy – or SMA – wires that provide considerable weight, power and volume reduction over existing techniques. This capability will enable designs with lower aerodynamic drag and improved fuel efficiency, thereby increasing aircraft range and endurance. Since no physical hinge joints are required, the actuators may be embedded directly within aircraft lifting surfaces, eliminating interference drag associated with control deflection.

• Zona Technology Inc., Model Updating Nonlinear System Identification Toolbox

The contract calls for the firm to refine a non-linear model methodology to arrive at improved flight flutter identifications that are rapidly validated with aeroelastic flight data sets. A parallel conventional technique will identify the underlying nonlinear structure of the dynamic system. This framework is capable of accounting for several nonlinearities including those due to aerodynamics, structures, control/actuator and/or geometry. This methodology will be used in online flutter-prediction applications to improve flight test safety.

• Research South Inc., Unstructured Mesh Movement and Viscous Mesh Generation for CFD-Based Design Optimization

The contract calls for the firm to develop a technique for generating an optimized grid to be used with computational fluid dynamics analysis methods to improve usability and produce more nearly optimal results. Successful early results with developing improved CFD grids will be incorporated into a general-purpose package. The verification and validation plan will follow the industry-standard approach now used by commercial software houses and will include an extensive set of NASA-relevant test cases. The software resulting from this contract is expected to have significant commercialization and sales potential in both the government and private sectors.

Rod Bogue, NASA Dryden's SBIR program manager, said the selections were based in part on each firm's performance under an earlier Phase I SBIR contact.

Those firms successfully completing work under a Phase II grant may apply for the third phase of the SBIR program to commercialize their product or service. Phase III requires the firms to obtain private financing or non-SBIR federal funding.

Overall, 124 small high-technology firms in 34 states will share about $84 million in SBIR Phase II contracts awarded by NASA this year, with several receiving more than one contract. The 140 projects funded were selected from 273 proposals submitted by firms completing SBIR Phase I projects.

The purpose of the NASA SBIR program is to stimulate technological innovation, increase the use of small business – including women-owned and disadvantaged firms – in meeting federal research and development needs, and increase private-sector commercialization of innovations derived from federally funded research. The program is managed at NASA's Goddard Space Flight Center, Greenbelt, Md., with oversight from NASA Headquarters, Washington, D.C. Individual SBIR projects are selected and managed by each of NASA's 10 field centers.

A complete list of all companies selected this year for an SBIR Phase II award is available at http://sbir.nasa.gov.

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and electrolyzer Lynntech were developing were critical. We knew there was a lot of potential for reducing the weight of the fuel cells and electrolyzer, but no one had done it because there was no real need to do so. All the applications for fuel cells were on the ground – or in submarines, where weight was not a big deal. But weight was huge for us."

In 2001, in Phase III of the proposal, Dryden entered into an agreement with Lynntech under the umbrella of the ERAST program. The parameters for this work called for developing full-size, flight-weight fuel cell and electrolyzer components that, it was hoped, had potential applications in future high-altitude, long-endurance aircraft. Del Frate said Dryden engineers were particularly interested in the weight, reliability and electrochemical efficiencies of the electrolyzer and fuel cell components.

"We wanted a very reliable system that would operate at high pressure, with high efficiency – and lightweight, by the way. We were requiring Lynntech to push the limits on all fronts," he said.

Early versions of the fuel cell and electrolyzer components were tested by AeroVironment and eventually integrated into a "flight-like" but heavy system that was successfully tested at National Technical Systems, Saugus, Calif. Dryden and AeroVironment stopped pursuing the regenerative fuel cell system development and NASA's Glenn Research Center, Cleveland, took over the effort with Lynntech. A recent report by Glenn researchers confirmed that the fuel cell technologies were successfully demonstrated through multiple tests. Now researchers want to test the electrolyzer and fuel cell "stack" through hundreds of day-night cycles to determine the system's durability.

The SBIR mechanism is an excellent research tool because it offers flexibility, the kind of flexibility that made investigating several fuel cell stack variations possible, Del Frate said.

"Part of the reason we even went down this path was because we needed something very aggressive for the energy storage system and nothing had been developed to date," he said. "Through the use of SBIR it helped us to look at a variety of different avenues and different companies and see fairly quickly where the most promising technologies were. It helped us leverage the money we had. In fact, we even used an SBIR from the Air Force. We were able to narrow it down to one company that seemed to have what it took to make the necessary advancements."

Lynntech was recently awarded a patent for the new fuel cell-related technology.

Dryden's Marty Brenner manages the Modeling, Identification, and Simulation for Control of Aerospace Vehicles subtopic. The subtopic's focus, he said, is encouraging development of "more efficient software tools for predicting and understanding the response of an airframe under the simultaneous influence of structural dynamics, thermal dynamics, steady and unsteady aerodynamics, and the control system."

Proposals in this area focus on tools or technologies that would lead to an increased understanding of complex interactions between the vehicle and its dynamic subsystems, with an emphasis on flight test validation methods for control-oriented applications. Control-oriented implies an emphasis towards vehicle stability, control, and performance in developing integrated design/analysis methods, while also considering hardware and software implementation issues.

"Proposals for novel multidisciplinary, nonlinear dynamic systems modeling, identification and simulation for control objectives are encouraged," Brenner said. "Control objectives include feasible and realistic boundary layer and laminar flow control, aeroelastic maneuver performance and load control including smart actuation and active aerostructural concepts, autonomous health monitoring for stability and performance, and drag minimization for high efficiency and range performance."

Methodologies explored in SBIR proposals submitted may pertain to a variety of aircraft – including uninhabited air vehicles and those that are remotely operated – and flight regimes ranging from those of low-speed, high-altitude, long-endurance aircraft to hypersonic and access-to-space vehicles, he added.

SBIR proposals can lead to valuable research and Brenner explained one such success.

"Successes have been in improved techniques in multi-physics sensing, for nonlinear system identification, and modeling schemes for very complex, multidisciplinary aerospace systems. These methods allow for improved model validation for flight test in a control-oriented context, i.e., amenable for integrating design and modeling with on-board signal processing, control system design and nonlinear adaptive control," he said.

Regardless of the issues that require exploration, or the scope of the problems being encountered, many researchers agree bite-size chunks can be addressed through SBIR/STTR proposals and will lead to tools, new concepts, or new directions.

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mospheric temperature and pressure are determined by fitting the theoretical model of Rayleigh scattering to the measured Rayleigh line shape.

A next step in the research could be flying the instrument aboard the Dryden ER-2, a proposal that the company submitted to Dryden as a potential SBIR Phase I contract.

"Ophir Corp. has indeed discussed testing this technology on an ER-2 with the NASA Dryden ER-2 test group," Spaeth said.

"The project objective is to demonstrate the Rayleigh/Mie lidar's capability for providing air data information at high altitudes where the presence of aerosols is greatly reduced. Measurement in this atmospheric regime is important for Optical Air Data systems, such as Ophir's Rayleigh/Mie lidar, to be accepted for high-altitude air vehicles such as the proposed re-entry vehicle for the NASA Crew Exploration Vehicle. Most OAD systems don't operate reliably in situations where there are little to no aerosols in the atmosphere, as is the case at high altitudes. There is interest from Dryden, but whether it will make the priorities list for funding, we don't know."

Ophir's OAD system uses a laser system and is marketed under the name sensAir. Algorithms currently used to convert the raw data from the OAD systems into useable information (atmospheric temperature and pressure, for example) will be improved in future projects such as the proposed Dryden ER-2 flights to optimize measurement accuracy. Key hardware and software modifications and preferred flight test plan

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on it. The NASA Web site does a really nice job of laying out what all the requirements are, what kinds of things are expected, and it has examples.

"The hard part is coming up with that good idea."

That's when Rolling Hills often relies on the creativity of its chief aerodynamicist, Michael Kerho, another one-time Eidetics employee who also has been with Rolling Hills since its inception. But while good ideas can sometimes be elusive, Rolling Hills has a solid track record and is currently involved with or proposing both Phase I and Phase II projects.

"You have to test the idea in Phase I and prove to yourself and NASA that the idea has some merit. It's really in Phase II where you take the idea and develop it," he said.

In order to strengthen his proposals, he and his staff make sure they do their homework. There is a lot of dialogue with Dryden researchers to ensure that what Rolling Hills officials plan to propose meets a specific need for Dryden and NASA.

Sources for basic research funding have been scarce in recent years, Kramer added, but SBIR/STTR contract funds are consistent. That provides companies with an attractive incentive for filing proposals.

"One of big benefits of the SBIR program is that it is one of the few funding sources available, especially for a small company, to take any kind of an idea through a basic research feasibility study and develop it into a commercially viable project," he said.

Teamed up with researchers from California Polytechnic State University, San Luis Obispo, Rolling Hills Research engineers currently are working on a Phase I STTR program. On the Cal Poly campus, Rolling Hills engineers are tapping the institution's rocket motor expertise for the study of an advanced aerospike rocket engine nozzle.

"We're branching out," Kramer explained. "Rocket propulsion is not our usual field of expertise but Cal Poly is helping us come up to speed on that. We're bench testing. They have a facility where they can do cold flow (of gasses) through these nozzles. We're using an advanced (computational fluid dynamics) code to extrapolate the results from the bench test up to what you would expect to see at high altitudes, where these (engines) would be used. So far we're seeing great results."

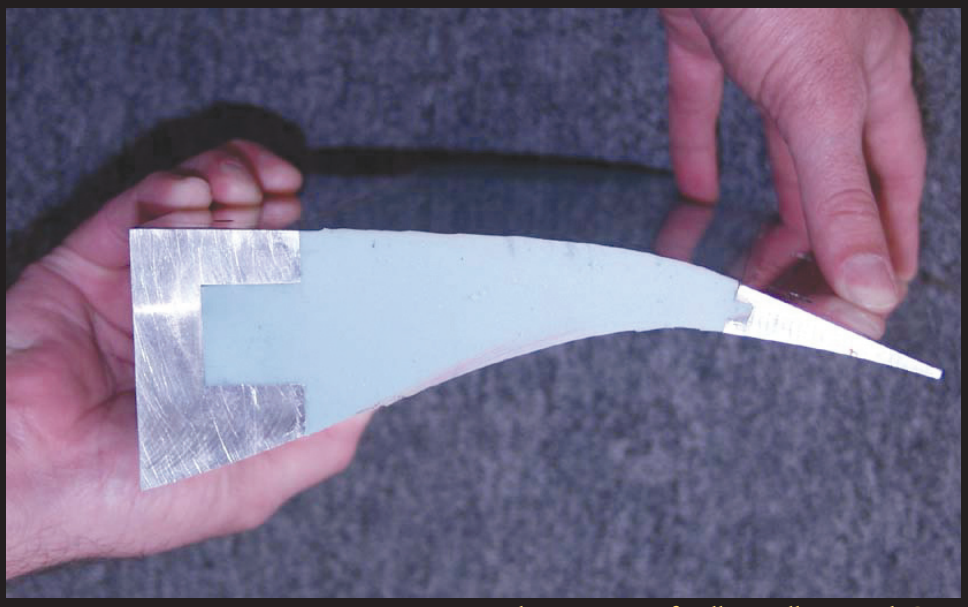

Photo courtesy of Rolling Hills Research Corp.

This piece of experimental hardware shows how flexible materials might be used for controlling an aircraft through warping like that demonstrated on the F/A-18 Active Aeroelastic Wing aircraft, rather than current flight control surfaces like ailerons.

Kramer anticipates that Rolling Hills will submit a Phase II proposal to continue the research.

In October, Rolling Hills was awarded a contract for a Phase II proposal to refine an approach to controlling the transition from smooth to turbulent airflow in conditions of low speed at high altitude. The novel transition-control technology was shown to reduce aerodynamic drag penalties by as much as 35 to 60 percent when compared to traditional techniques which displayed penalties as much as 190 percent at off-design conditions. Potential applications for the technology include those in micro unmanned air vehicles; high-altitude, long-endurance aircraft; Mars exploratory flyers and propeller systems.

"It has good commercialization prospects," Kramer said of the project. "It involves very low Reynolds number performance enhancement for aircraft. It applies to two seemingly very different kinds of aircraft that are very closely related. That includes the real high-altitude, long-endurance aircraft and the very small, micro UAVs. The thing that ties them together is they both operate with really low Reynolds numbers. Our technology fits nicely into that."

Rolling Hills Research engineers recently received funding from NASA's Langley Research Center, Hampton, Va., for a Phase III agreement that bridged the SBIR research done at Eidetics and Rolling Hills to commercialize the latter's advanced water tunnel facilities. In addition, Rolling Hills has nearly completed a Phase II SBIR project with the U.S. Army's Aeroflightdynamics Branch for development of a compliant-structure helicopter rotor blade that can change shape to optimize for local conditions when the blade rotates, Kramer said.

For those reasons and others, Kramer said the SBIR program has been vital to the success of his small but cutting-edge business.

"It's been a real benefit to us," he emphasized. "We're starting to focus on how to take an idea in the SBIR process and develop it before the end of Phase II into something that's commercially viable. In aeronautics it's challenging because normally our customers

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methodology will be determined from flight test results and analysis. The project is critical for determining the key improvements required for the technology to become commercially viable, Spaeth said.

The OADS system is not yet commercially available. Further flight testing and hardware modifications must be made before the technology will be ready for commercialization

Meanwhile, the lidar instrument has attracted attention from other partners interested in funding additional work.

"We received funding that totaled more than NASA contributions (for Phase I and Phase II). We're very excited about the chance to work with our new partner and further this OADS. It never would have happened without the NASA Dryden (SBIR Phase I and Phase II) contracts. That's really how (the potential partners) learned about our OADS and became interested in what we were doing," O'Brien said.

Concerning SBIR proposals, Spaeth said submitting a proposal is not difficult and Dryden researchers are an excellent resource.

"Submitting proposals under the NASA SBIR program has been straightforward. The instructions for submittal are clear and easy to understand. For our recent SBIR submission to NASA Dryden, Dryden researchers were very helpful. They provided much-needed guidance and recommendations for project definition and focus," she said.

SBIR contracts have been beneficial to the company in many ways.

"The biggest benefit to Ophir's partnership with the NASA Dryden SBIR team has been the ability to take the OADS from concept to prototype. The prototype demonstration provided an opportunity for Ophir to demonstrate the viability of the OADS and share the results with potential Phase III partners. The Rayleigh/Mie lidar project has received additional Phase III funding for development of a three-axis air data system. This work is ongoing. Ophir has also received interest from the commercial aircraft community regarding the optical air data system demonstrated under this Phase II program," Spaeth said.

Ophir intends to bring other proposals for innovative ideas up for consideration in future SBIR contract evaluations.

"(SBIR research) is an essential steppingstone in taking an idea or technology from the initial concept stage to a working prototype, and ultimately to a demonstration phase. In addition, this research funding is critical to allowing Ophir to demonstrate the technology's capability and performance to potential Phase III commercialization partners," she said.

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are large airframers, who have their own research groups. We're trying to broaden our applications as much as possible and look at areas where there are a lot more (potential end) users.

"What we're concentrating on right now is the UAV area because so many people are developing these kinds of vehicles and they run the gamut from very, very expensive aircraft on down to the hobbyist market. We're trying to develop technologies that will really enhance the performance of these kinds of vehicles and give them much longer range and better safety."

Another success for Rolling Hills was a Phase III agreement on the company's time-dependent, nonlinear aerodynamics work.

"The idea is that the flow field often lags behind the position an aircraft is in, and that kind of lag in the flow field could make it difficult to predict the aerodynamics, or to simulate them," Kramer explained. "We were using a water tunnel facility with a computer-controlled model support that can reproduce dynamic aircraft motions and a submersible strain gage balance that we developed – years ago, under another SBIR funded by NASA Dryden. The system allows us to use the water tunnel very much like a wind tunnel, but it's got a couple of distinct advantages."

One of those is that when the rotational rates for an aircraft are scaled down so as to be appropriate for a water tunnel, the rates are very slow, which means the inertial forces are a much smaller component of the total forces. In other words, under such conditions it becomes much easier to extract aerodynamic information. Another major advantage is that the flow visualization in a water tunnel is excellent and can help diagnose what is driving aerodynamic forces, he said.

Kramer said his company has realized many benefits working on SBIR/STTR contracts.

"The ability to look at some of these basic concepts and have a way of finding out just how feasible they are is a big benefit," he said. "Another is being able to work with the people at Dryden. They have a lot of really great resources, whether it's in computational fluid dynamics, flight testing, or just tapping the Center's tremendous amount of expertise."

Nothing is certain in research, but what can be counted on is that Rolling Hills Research Corp. will enter the SBIR/STTR process again with more new and innovative ideas.

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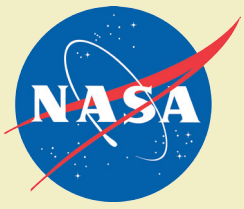

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